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SOLDERS FOR JOINING BLADES TO TOOL SHANKS

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Solders for joining high-speed steel blades to shanks made of carbon steel or iron as a rule must have a melting point close to the hardening temperature of high-speed steel. The use of solders whose melting point is higher than 1,300 degrees centigrade is not recommended since the edges of the cutting blades would melt.

The utilization of solders with a melting point of 20-40 degrees below the hardening temperature of high-speed steels permits soldering with simultaneous air hardening of th tool.

In addition, with the utilization of these solders, the tool can be heated twice (for soldering and hardening). This is done if there is insufficient air cooling during soldering or if soldering is done with repeated heating (multi-blade mills). The high-speed steel blades are then inserted and secured to the shank of the tool.

During hardening, the solders are held in place between the blades and shank by capillary force There is less flowability as compared to the initial state because during soldering, the composition of the solder becomes more refractory as a result of the diffusion of iron in the connecting parts.

At present, high-speed steels are soldered with GFF and GFK solders. The composition of these solders is given in the following table:

Name of Solder	Composition of Elements, in %: Copper	Nickel	Iron	Manganese	Ceramics	Zinc	Melting point (degrees centigrade)
GFF	66-72	10-14	12-14	4.2-5.0	1.0-1.8	--	1,180-1,280
GFK	74	4.0	6.0	4.5	4.0	7.5	1,150

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The melting point of GPF solder can be changed by changing the percentage of the different elements.

In special cases, welding powders are used for soldering high-speed steel blades. They are composed of ferromanganese, ferrosilicon, or mixtures of them. Frequently, fluxes such as ground glass and borax are added to their composition:

Composition of Welding Powders, in %

Ferro-manganese	Ferro-silicon	Steel Chips	Iron Chips	Copper Chips	Ground Glass	Dehy-drated Borax	Commer-cial Soda	Melting Point, (degrees centigrade)
60	--	--	--	--	30	10	--	1,300-1,320
80	--	--	--	20	--	--	--	1,160-1,180
75	--	--	--	25	--	--	--	1,160-1,180
--	32	10	--	16	--	32	10	1,250-1,280
40	10	--	20	5	15	10	--	1,190-1,300

The effectiveness of these powders differs little from that of solders. However, since they have less flowability as compared with ordinary solders, they have little resistance to bending stresses. For this reason, they are used for the most part on single-blade tools.

Hard metal-ceramic (powder-metallurgy) alloys do not require any heat treatment and can, without detriment to the cutting properties, be heated during soldering to 1,100-1,150 degrees centigrade. Only in heating special titanium-carbide alloys to very high temperatures can fractures occur.

The basic requirements for solder for hard alloys are as follows:

1. The solder must have a melting temperature of from 900 to 1,100 degrees centigrade.

2. In addition to high mechanical strength, the solder must have high plastic properties.

Among the solders used for soldering hard alloys, the best are copper-nickel alloys, electrolytic copper, brasses with nickel added, and pure brasses. The composition of these solders is shown in the following table.

Composition, in %

Name of Solder	Copper	Nickel	Zinc	Lead	Manga-nese	Aluminum	Melting Temperature, (degrees centigrade)
Copper-nickel-zinc	66-68	26-28	3.0	--	--	0.8-1.0	1,100-1,150
Copper-nickel-zinc	85-87	8-10	3.0	--	--	0.8-2.0	1,020
VNIIS	90	3	--	--	2	5	1,100-1,150
KM	58-60	8-9	3.0-3.2	1-2	--	--	950-980

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Composition, in %

Name of Solder	Copper	Nickel	Zinc	Lead	Manga-nese	Aluminum	Melting Temperature (degrees centigrade)
PMTs52 (GOST 1534-42)	49-53	--	47-51	--	--	--	876
PMTs 47 (GOST 1534-42)	45-49	--	51-55	--	--	--	860
Electrolytic copper	99.9	--	--	--	--	--	1,083

The first three solders can be used for all hard alloys in tools operating under a big load. If the hard-alloy blades become fractured in soldering, or in the process of grinding or lapping, it is recommended that KM solder, which has a lower melting point, be used.

For tools operating under a small load (drills up to 15 millimeters in diameter and small cutting tools), solders (PMTs-52 and PMU-47) which have a lower melting point can be used in the form of a foil.

The use of electrolytic copper under conditions of heating without a reducing atmosphere is not recommended because the soldering process takes place at a temperature of 1,120-1,150 degrees centigrade and leads to the intensive oxidation of the solder, thus lowering the strength of the joint.

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